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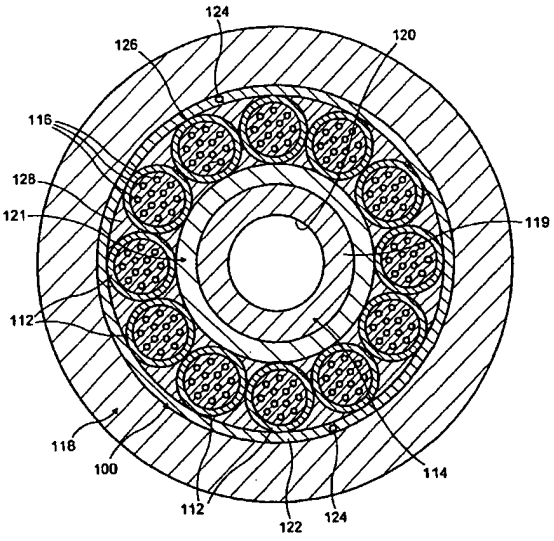
(54) Title: OPTICAL FIBRE CABLE



(57) Abstract: An optical fibre cable for blown installation has a tubular central strength member (114) about which tubes (112) loosely housing optical fibres (116) are stranded. The jacket (118) is preferably formed from a high density polyethylene material and is extruded over the core (100) on which rip cords (124) are positioned. Water blocking compound (126) is provided in each tube (112) in any spaces therein which would otherwise be void. Also a water blocking material (128) is provided between the sheath (121) and the layer defined by the helically wound wrapping tape (122) or binding yarn in any spaces between the tubes (112) which would otherwise be void.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Optical Fibre Cable

This invention relates to optical fibre cable and more particularly although not exclusively to such cable for blown installation.

One method of installing an optical fibre cable in a duct comprises blowing the cable into the duct using gaseous flow which is fed into an inlet end of the duct together with the cable. The length of cable which can be blown into the duct can be increased by applying an additional pushing force to the cable at the inlet end of the duct. Optical fibre cables for blown installation do not have to withstand high tensile loads (unlike cables which are to be pulled through ducting) but they do require a degree of stiffness for the application of the pushing force.

A design of optical fibre cable marketed by Pirelli Cables Ltd under the designation 'Multi-Element Loose Tube' (MLT) is shown in Figure 1 and has a core 10 comprising a plurality of tubes 12 stranded about a central, solid strength member 14 and a plurality of optical fibres 16 in each tube 12, and a jacket 18 surrounding said core 10. An aluminium/plastics laminate tape 20 surrounds the tubes to retain the same about the strength member 14 and also to act as a moisture barrier and, because it is electrically conductive, to enable location of the cable to be detected. Also spaces within each tube which would otherwise be void are filled with a water blocking material 22.

One object of the invention is to provide an optical fibre cable for blown installation with improved installation performance.

To this end the present invention provides an optical fibre cable having a core comprising at least one tube stranded about a central strength member and at least one optical fibre loosely housed in said at least one tube, and a jacket surrounding said core, wherein said central strength member is tubular, said central strength member having a peripheral wall enclosing a passage extending along the length of said central strength member.

The at least one tube stranded about the central strength member need not contact the central strength member. Thus a sheath may be disposed between said central strength member and said at least one tube.

The central strength member may be formed in a fibre reinforced plastics material, for example a glass fibre reinforced plastics material.

At least one elongate element enabling cable location detection may be accommodated within and extend along the length of said passage of the central strength member.

Alternatively or additionally at least one tube member loosely housing at least one optical fibre may be accommodated within and extend along the length of said passage of the central strength member.

Alternatively or additionally at least one empty tube member for blown optical fibre installation may be accommodated and extend along the length of said passage of the central strength member.

In order that the invention may be well understood some embodiments thereof which are given by way of example only will now be described with reference to the accompanying drawings in which:

Figure 1 is a radial cross-section of a known optical fibre suitable for blown installation; and

Figures 2 to 5 are respective radial cross-sections of four optical fibre cables for blown installation which embody the present invention.

The cables illustrated in Figures 2 to 5 each have a core 100 comprising a plurality of polymeric tubes 112 stranded about a central strength member 114 and a plurality of optical fibres 116 in each tube 112, and a polyethylene jacket 118 surrounding the core 100. In each cable, the central strength member 114 is tubular - the central strength member having a peripheral wall 119 enclosing a passage 120 extending along the length of the strength member 114.

A polymeric sheath 121 is disposed between the central strength member 114 and the tubes 112.

The tubular central strength member 114, which typically has an outer diameter of 3 to 8 mm and a wall thickness of 0.75 to 2.5 mm, is formed of a fibre reinforced plastics material such as a glass fibre reinforced plastics material. However, resin matrices such as carbon and aramid composites may also be used for the central strength member. The strength member 114 may be formed with aramid yarn in a stranded layer. It is also envisaged that an

engineering polymer per se may be used. Further the strength member may be a thin wall metal tube.

Helically wound wrapping tape 122 surrounds the tubes 112 to retain the tubes 112 which are preferably stranded with an alternating, or so-called S-Z lay in position against the sheath 121 during manufacturing and handling of the core. Instead of the wrapping tape, a binding yarn may be used. The wrapping tape may be made from paper or plastics. Suitable materials include polyethylene, polyester, water swellable composite structures and metallic film structures. Typical yarns include polyester, polypropylene and polyethylene.

The jacket 118 is preferably formed from a high density polyethylene material and is extruded over the core 100 on which rip cords 124 are positioned. Water blocking compound 126 is provided in each tube 112 in any spaces therein which would otherwise be void. Also a water blocking material 128 is provided between the sheath 121 and the layer defined by the helically wound wrapping tape or binding yarn in any spaces between the tubes 112 which would otherwise be void.

It will be noted that a difference between the known design of cable illustrated in Figure 1 and the cables embodying the invention illustrated in Figures 2 to 5 is that the central strength member 14 in Figure 1 is solid, ie formed as a rod whereas the central strength member 114 in each of the embodiments shown in Figures 2 to 5 is tubular. The provision of a tubular

central strength member instead of a solid central strength member reduces the weight per unit length of the cable whilst increasing its stiffness against radial deformation on application of a pushing force by a caterpillar device or the like at the inlet end of the duct into which the cable is being installed about its central axis. The decrease in weight and the increase in stiffness each increase the distance to which the cable may be blown.

Figure 2 shows a cable in which the passage 120 of the tubular central strength member 114 is left void.

Figure 3 shows a cable in which a tube 130 loosely housing a plurality of optical fibres 132 is accommodated within and extends along the length of the passage 120. Preferably any spaces within the tube 130 which would otherwise be void are filled with a water blocking compound.

As will be appreciated, the cable of Figure 3 has a higher number of optical fibres than that of Figure 2 with no increase in outside diameter of the cable through its utilisation of the passage 120.

Figure 4 shows a cable in which empty tubes 140 are accommodated within and extend along the length of the passageway. Each empty tube 140 is able to have an optical fibre blown therein to increase the number of optical fibres in the cable without increasing its outside diameter.

Figure 5 shows a cable in which a detectable elongate element 150 is accommodated within and extends along the length of the passage 120. This element enables the location of the cable when it is buried or otherwise

concealed to be determined. The element 150 preferably comprises an electrically conductive element such as a copper wire or twisted pair.

In the cables shown in Figures 2 to 5 the tubular central strength member 114 is preferably manufactured by pulltrusion with a cross head feed for the introduction into the passage 120 of the tube 130 of loosely housed optical fibres 132 in the case of Figure 3, the empty tubes 140 in the case of Figure 4 or the detectable elongate element 150 in the case of Figure 5. Alternatively, the tube 130, the tube 140 or the element 150 may be blown into the passage 120 after manufacture of the tubular strength member 114.

In the cables shown in Figures 2 to 5, the aluminium/plastics laminate tape 20 of the cable shown in Figure 1 has been omitted. As stated above, this tape is provided in the cable of Figure 1 to act as a moisture barrier and to enable the location of the cable to be detected. Replacement of this tape 20 with paper or plastics tape 122 or binding yarn reduces the weight of the cable enabling the distance the cable can be blown into a duct of the same internal diameter to be increased.

Also the presence of the layer of aluminium/plastics laminate provides the cable with a shape memory which hinders unwinding of the cable from a drum during installation, the unwound cable being blown into the duct tending to take a spiral rather than straight form. Accordingly replacement of the aluminium/plastics laminate tape 20 with paper or plastics tape 122 or binding

yarn improves the unwinding characteristics of the cable and thus increases the distance the cable can be blown.

However, it is to be understood that in the embodiments of Figures 2, 3 and 4 the aluminium/plastics laminate tape 20 may be used instead of tape 122 to enable the location of the cable to be determined.

Alternatively the embodiments of Figures 2, 3 and 4 may be modified to include an elongate element 150 within and extending along the passage 120 for cable location detection.

Whilst a plurality of tubes 112 (shown as twelve) are provided in the cables of Figures 2 to 5, it is to be understood that these cables may be provided with more or less tubes 112 and in an extreme case with only one such tube 112. Similarly, whilst each tube has a plurality of optical fibres (shown as twelve) loosely housed therein it is to be understood that more or less fibres and in an extreme case only one such optical fibre maybe provided within the or each tube 112.

CLAIMS:

1. An optical fibre cable having a core comprising at least one tube stranded about a central strength member and at least one optical fibre loosely housed in said at least one tube, and a jacket surrounding said core, wherein said central strength member is tubular, said central strength member having a peripheral wall enclosing a passage extending along the length of said central strength member.

2. An optical fibre cable as claimed in claim 1, wherein a sheath is disposed between said central strength member and said at least one tube.

3. An optical fibre cable as claimed in claim 1 or 2, wherein said central strength member is formed in a fibre reinforced plastics material.

4. An optical fibre cable as claimed in claim 1, 2 or 3 wherein at least one elongate element enabling cable location detection is accommodated within and extends along the length of said passage of the central strength member.

5. An optical fibre cable as claimed in any one of claims 1 to 4, wherein at least one tube member loosely housing at least one optical fibre is

accommodated within and extends along the length of said passage of the central strength member.

6. An optical fibre cable as claimed in any one of claims 1 to 5, wherein at least one empty tube member for blown optical fibre installation is accommodated and extends along the length of said passage of the central strength member.

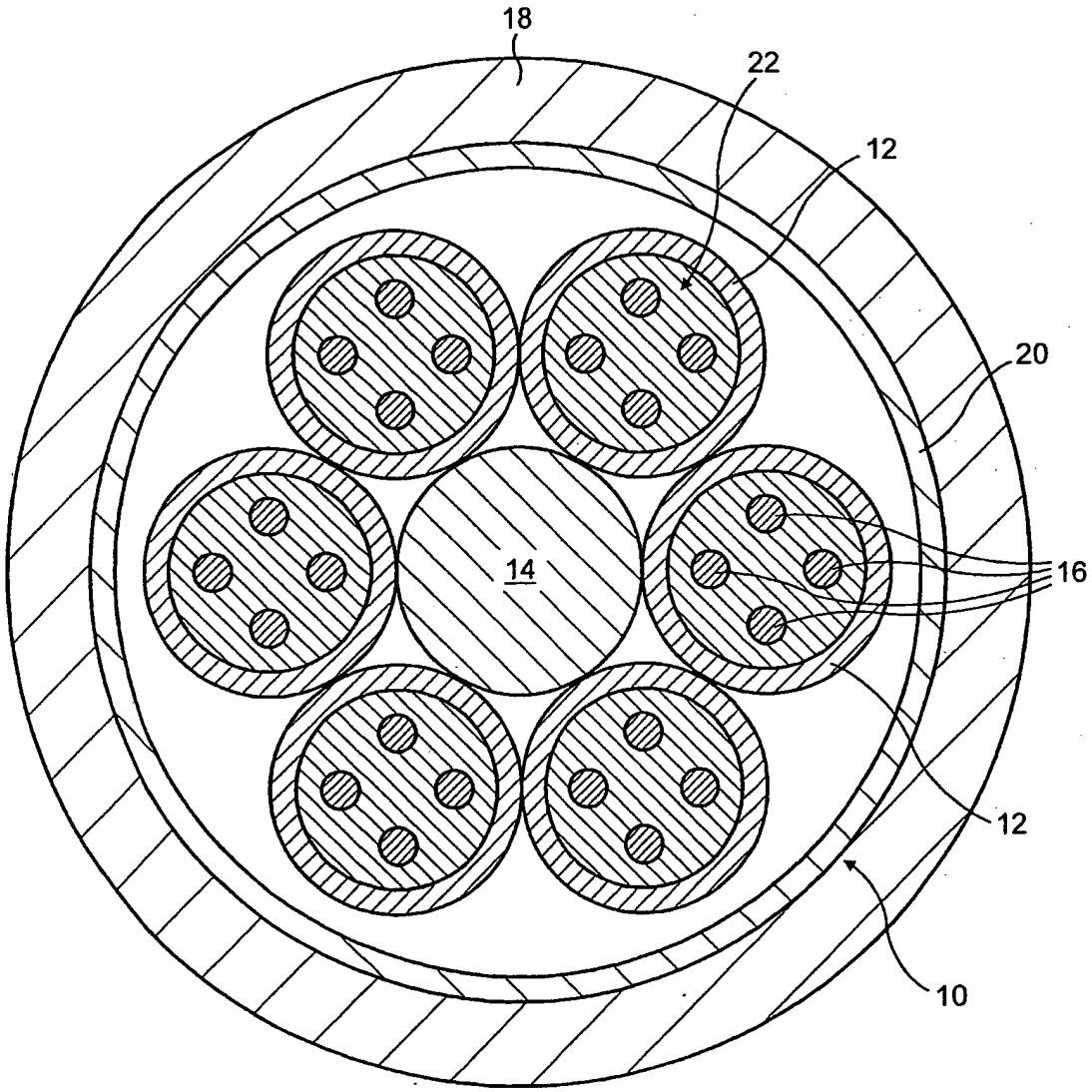

FIG. 1

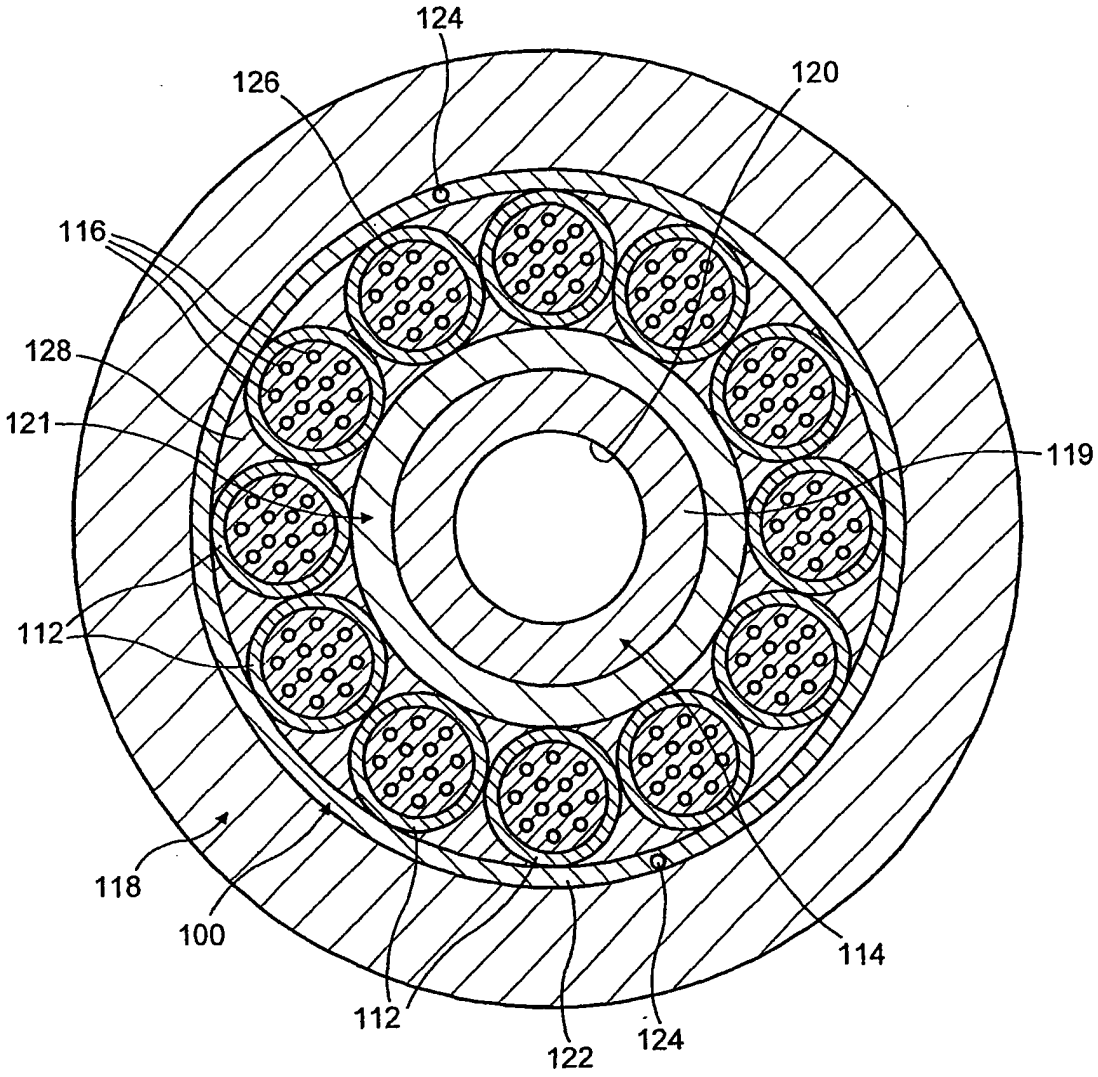

FIG. 2

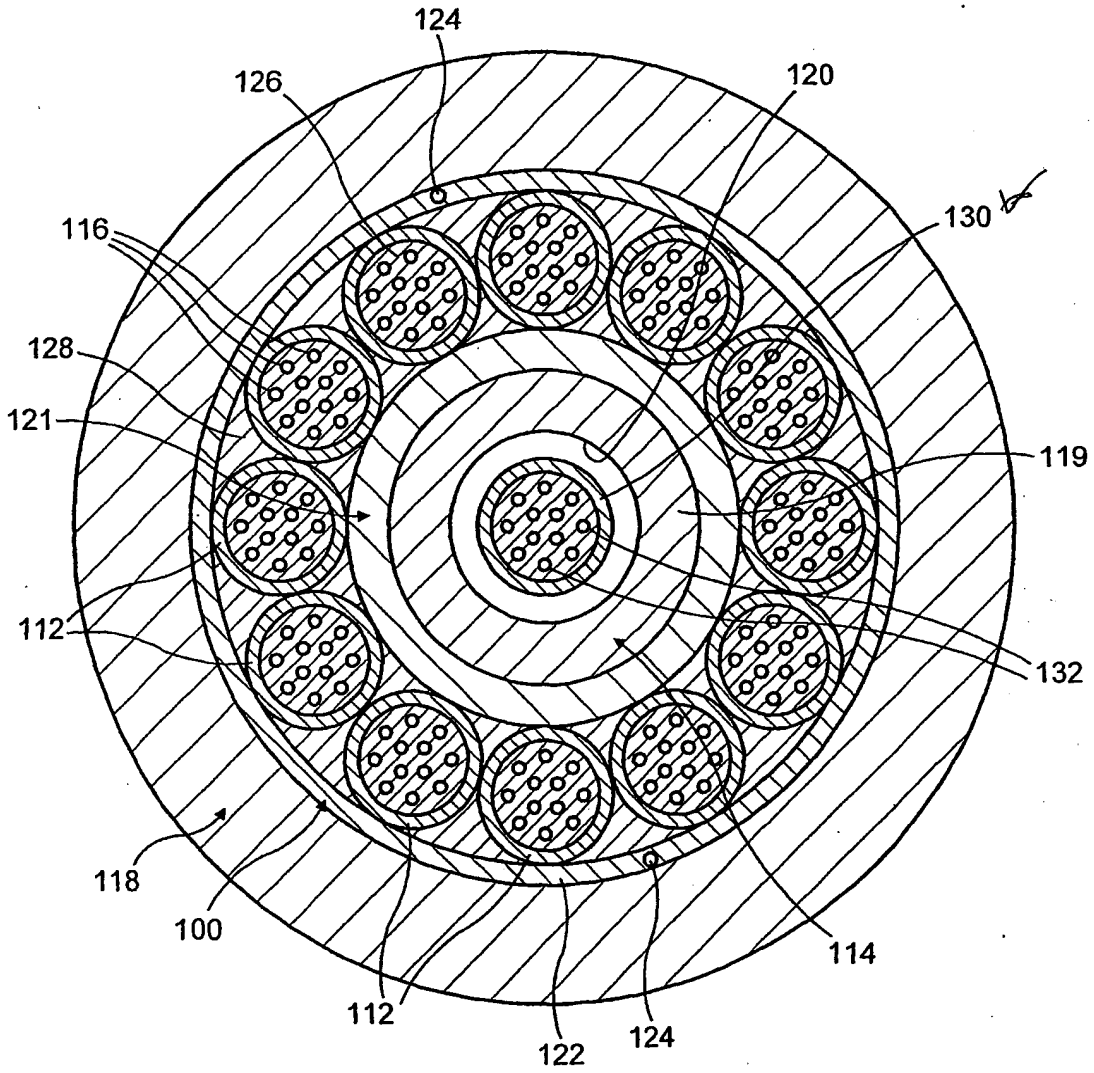

FIG. 3

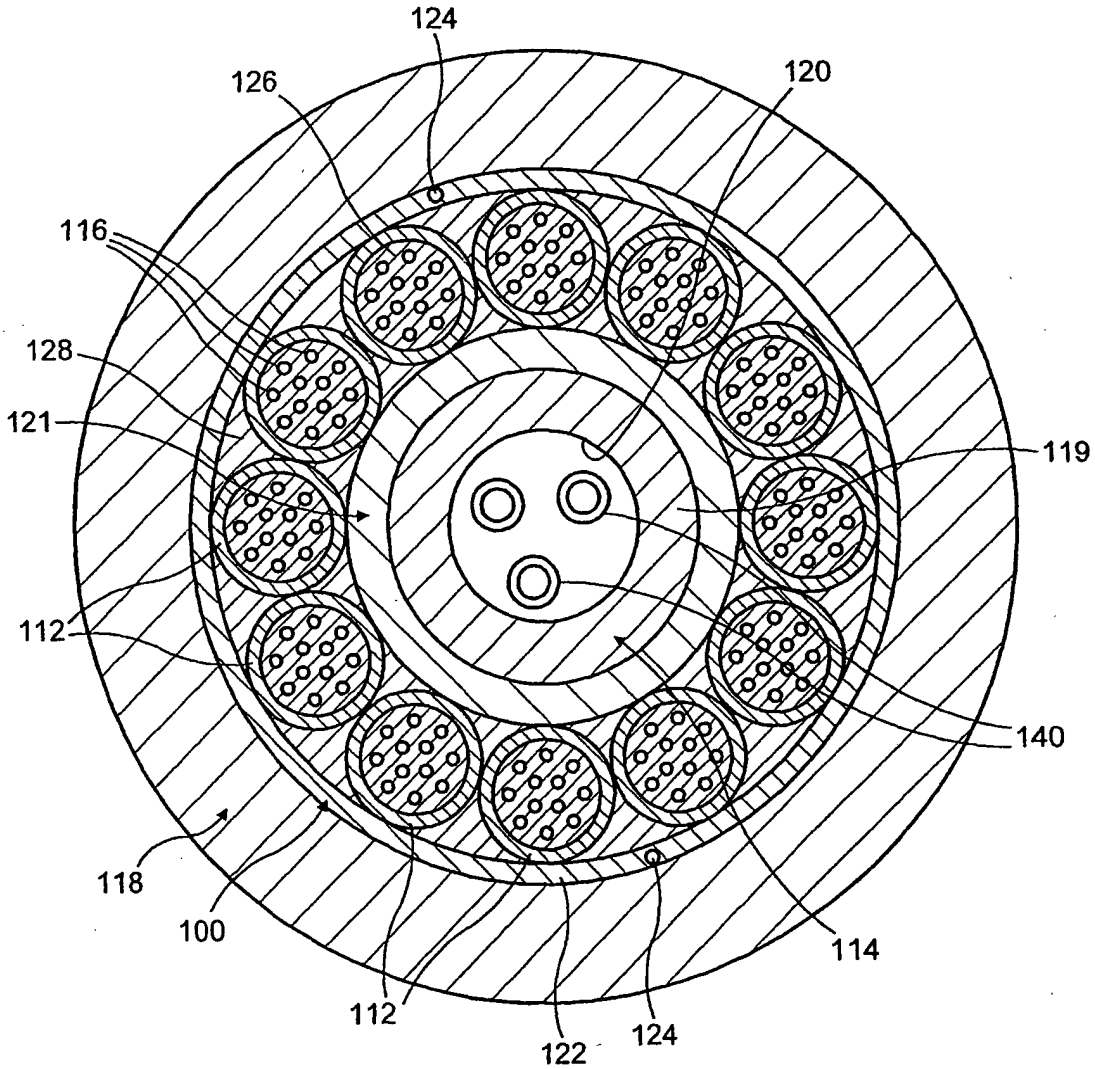

FIG. 4

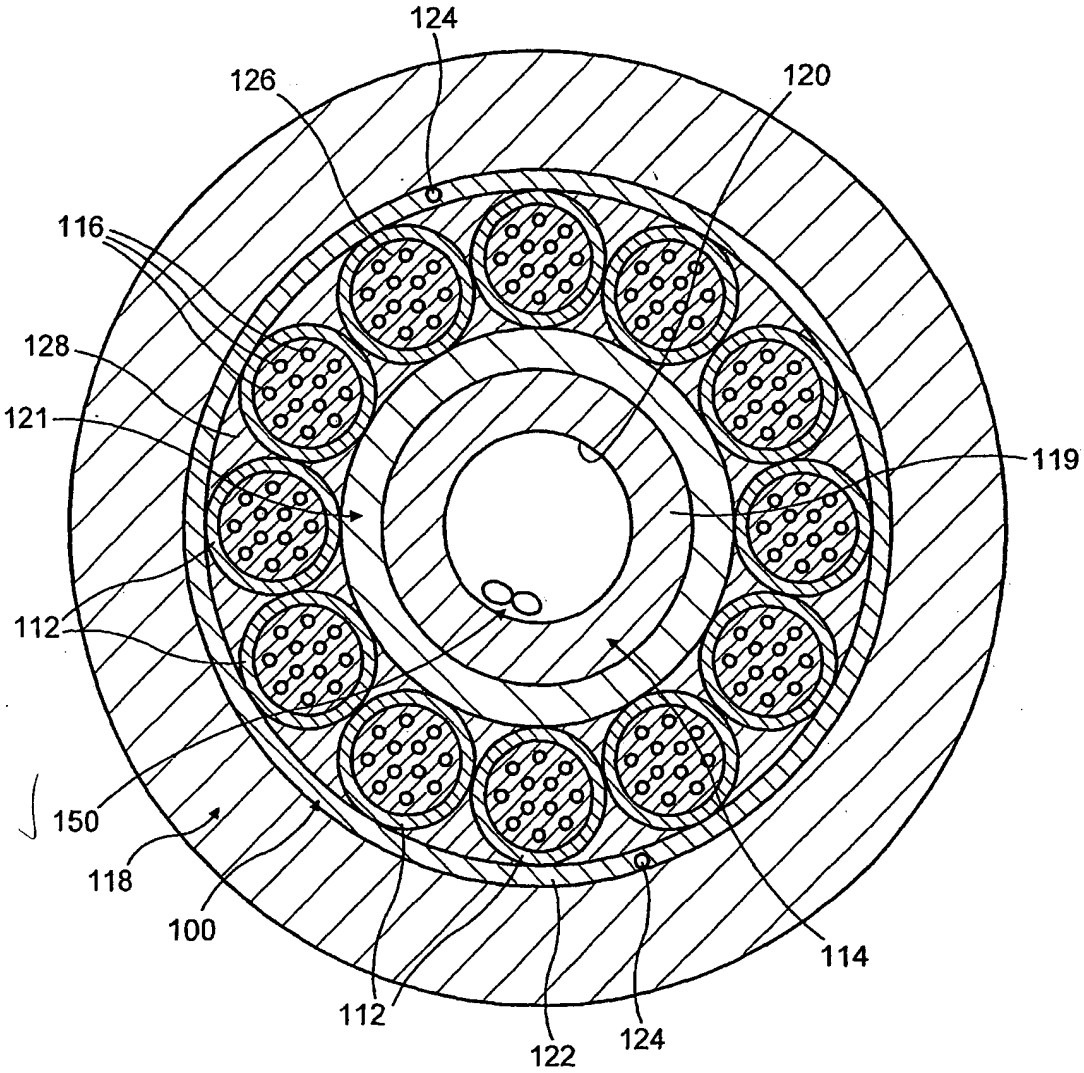

FIG. 5

INTERNATIONAL SEARCH REPORT

Int[illegible]al Application No
PCT/GB 01/03343

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B6/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E A	US 6 101 304 A (STAMMELY THOMAS E ET AL) 8 August 2000 (2000-08-08) claims; figures	1,5,6 2,3
A	EP 1 004 914 A (PINACL COMMUNICATION SYSTEMS L) 31 May 2000 (2000-05-31) claims; figures	1
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A	EP 0 456 909 A (CORNING INC) 21 November 1991 (1991-11-21) claims; figures	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 November 2001	19/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Mathyssek, K

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ɔnal Application No
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